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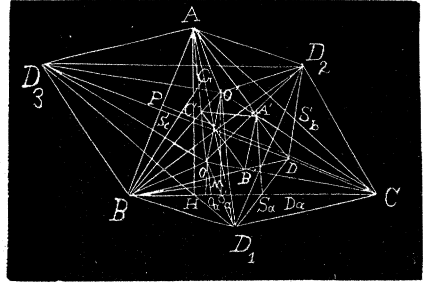
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CD_3 intersect at the same point. For BD_2 and CD_3 bisect each other, also BD^2 and AD_1 bisect each other.

$\therefore BD_2, AD_1$, and CD_3 bisect one another in the same point. Since triangle BDC = triangle D_3AD_2 , DD_a = the perpendicular distance from A to D_2D_3 .

Draw $AH, OO_a, O'O_a, DD_a$ perpendicular to BC ; then the point of intersection of the three lines AD_1, BD_2, CD_3 is distant from $BC, \frac{1}{2}(AH - DD_a)$.



$$DD_a = \frac{2b^2c^2 \cdot \Delta}{a(a^2b^2 + a^2c^2 + b^2c^2)}. \quad (\text{Schwatt's Curves, p. 10}).$$

$$AH \cdot a = 2\Delta. \quad \therefore AH = \frac{2\Delta}{a}.$$

$$\frac{AH - DD_a}{2} = \frac{\Delta \cdot a(b^2 + c^2)}{(a^2b^2 + a^2c^2 + b^2c^2)} = \frac{OO_a + O'O_a}{2}. \quad (\text{Schwatt's Curves, p. 9}).$$

$\therefore AD_1, BD_2, CD_3$ intersect at the mid-point of OO' .

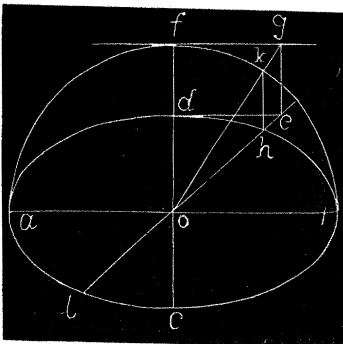
$\therefore$ Since AD_1, OO' ; BD_2, OO' ; CD_3, OO' all bisect one another, the quadrilaterals $AOD_1O', BOD_2O', COD_3O'$ are parallelograms.

55. Proposed by FREDERICK R. HONEY, Ph. B., New Haven, Connecticut.

Let ab and cd be respectively the major and minor axes of an ellipse, and let α be the angle which a diameter lh forms with the major axis; it is required to find the length of this diameter.

I. Solution by the PROPOSER.

SOLUTION. Draw the semicircle afb on the diameter ab . Produce cd to f , and draw the tangents to the ellipse and the circle parallel to ab at the points d and f respectively. Produce lh to intersect de at e . Draw eg perpendicular to ab intersecting fg at g . Draw go intersecting the semicircle at k . Draw kh perpendicular to ab intersecting oe at h one extremity of the diameter lh .



ANALYSIS. The semiellipse adb may be considered as the projection on the plane of the paper of the semicircle afb , the latter being revolved about the diameter ab into a position when f is projected at d . The tangent fg which is parallel to ab is projected at de also parallel to ab . The points e and h are respectively the projections of g and k . Since the projection of every point on the

semicircle is found in a line drawn through it perpendicular to ab , the axis about which the semicircle revolves, kh drawn perpendicular to ab intersects oe at h and gives one point of the ellipse; and therefore one extremity of the diameter lh .

II. Solution by H. C. WHITAKER, A. M., Ph. D., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania; W. H. CARTER, Professor of Mathematics, Centenary College of Louisiana, Jackson, Louisiana; and J. O. MAHONEY, B. E., Assistant in Mathematics, Vanderbilt University, Nashville, Tennessee.

If we denote ab by a , cd by b and tangent α by m , we have the equations

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \text{ and } y = mx \text{ which intersect at}$$

$$\left(\frac{ab}{\sqrt{b^2 + a^2 m^2}}, \frac{abm}{\sqrt{b^2 + a^2 m^2}} \right) \text{ and } \left(-\frac{ab}{\sqrt{b^2 + a^2 m^2}}, -\frac{abm}{\sqrt{b^2 + a^2 m^2}} \right),$$

the distance between these points being equal to

$$2ab \sqrt{\frac{1 + m^2}{b^2 + a^2 m^2}}.$$

Also solved by G. B. M. ZERR, J. SCHEFFER, and WILLIAM HOOVER.

PROBLEMS.

60. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

Prove that the loci of the foci of the variable ellipses form a pair of circles passing through the extremities of the major axis of the fixed ellipse and having for diameters the semi-latus rectum of the fixed ellipse.

61. Proposed by WILLIAM E. HEAL, Member of the London Mathematical Society, and Treasurer of Grant County, Marion, Indiana.

Let the bisectors of the angles A , B , C of a triangle intersect in O and meet the sides opposite A , B , C in A' , B' , C' . Prove that the perpendiculars from O on the sides of the triangle $A'B'C'$ are $p_1 = \frac{rR}{d_1}$, $p_2 = \frac{rR}{d_2}$, $p_3 = \frac{rR}{d_3}$

where r , R are the radii of the inscribed and circumscribed circles of the triangle ABC and d_1 , d_2 , d_3 are the distances of the center of the circumscribed circle from the centers of the three escribed circles.

62. Proposed by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

Prove that two triangles are equal if they have two sides and the median of one of them equal, each to each.